

CLAIMS

What is claimed is:

1. A method, comprising:

digitally recording a spatially-heterodyned hologram including spatial heterodyne fringes for Fourier analysis using a reference beam and an object beam;

Fourier analyzing the digitally recorded spatially-heterodyned hologram, by shifting an original origin of the digitally recorded spatially-heterodyned hologram to sit on top of a spatial-heterodyne carrier frequency defined by an angle between the reference beam and the object beam, to define an analyzed image;

digitally filtering the analyzed image to cut off signals around the original origin to define a result; and

performing an inverse Fourier transform on the result,

wherein the object beam is transmitted through an object that is at least partially translucent.

2. The method of claim 1, further comprising calculating a difference in thickness (δ) between a first through section of the object and a second through section of the object as

$$\delta = \frac{\Delta\theta\lambda}{2\pi(N_2 - N_1)}$$

where $\Delta\theta$ is a phase difference, λ is a wavelength of a source of coherent light energy, N_1 is an ambient index of refraction and N_2 is an index of refraction of the object.

3. The method of claim 1, further comprising calculating a phase difference ($\Delta\theta$) between a first portion of the object and a second portion of the object as

$$\Delta\theta = \frac{2\pi d}{\lambda}(N_3 - N_2)$$

where d is a thickness of both the first portion of the object and the second portion of the object,

λ is a wavelength of a source of coherent light energy, N_2 is an index of refraction of the first portion of the object and N_3 is an index of refraction of the second portion of the object.

4. The method of claim 1, further comprising calculating an index of refraction (N_2) characterizing a portion of the object as

$$N_2 = \frac{\Delta\theta\lambda}{2\pi d} + N_1$$

where $\Delta\theta$ is a phase difference, λ is a wavelength of a source of coherent light energy and N_1 is an ambient index of refraction.

5. The method of claim 1, further comprising moving the object within a plane that is substantially perpendicular to an axis defined by the object beam after digitally recording the spatially-heterodyned hologram.

6. The method of claim 5, further comprising digitally recording another spatially-heterodyned hologram after moving the object within the plane.

7. The method of claim 1, wherein the spatially-heterodyned hologram is digitally recorded with a charge coupled device camera or a CMOS imager.

8. The method of claim 1, wherein the reference beam and the object beam are generated by a laser operating in pulse mode.

9. A photolithographic mask inspection process comprising the method of claim 1.

10. A metrology process comprising the method of claim 1.

11. An apparatus, comprising:
a source of coherent light energy;
a reference beam subassembly optically coupled to the source of coherent light;

an object beam subassembly optically coupled to the source of coherent light;
a beamsplitter optically coupled to both the reference beam subassembly and the object beam subassembly; and
a pixilated detection device optically coupled to the beamsplitter,
wherein the object beam subassembly includes an object that is at least partially translucent, the object transmissively optically coupled between the source of coherent light energy and the beamsplitter.

12. The apparatus of claim 11, further comprising another beamsplitter i) optically coupled between the source of coherent light energy and the reference beam subassembly and ii) optically coupled between the source of coherent light energy and the object beam subassembly.

13. The apparatus of claim 11, wherein the reference beam subassembly includes an illumination lens.

14. The apparatus of claim 11, wherein the reference beam subassembly includes a mirror.

15. The apparatus of claim 11, wherein the object beam subassembly includes an imaging lens.

16. The apparatus of claim 11, wherein the object beam subassembly includes a mirror.

17. The apparatus of claim 11, wherein the object beam subassembly includes a relay lens.

18. The apparatus of claim 11, wherein the object beam subassembly includes an illumination lens.

19. The apparatus of claim 11, wherein the pixilated detection device includes a charge coupled device camera or a CMOS imager.

20. The apparatus of claim 11, wherein the source of coherent light energy includes a laser operated in pulse mode.
21. A photolithographic mask inspection instrument comprising the apparatus of claim 11.
22. A metrology instrument comprising the apparatus of claim 11.